Strategic Plan for Improving Mathematics Achievement in Kentucky
Committee for Mathematics Achievement
September 2005

In March 2005, the Governor signed into law House Bill 93 which established the Committee for Mathematics Achievement (CMA) and required it to develop and ultimately oversee a multi-faceted strategic plan to improve student achievement in mathematics at all levels of schooling in Kentucky. The CMA was formed in May 2005 and met five times during the summer of 2005. (See attachment for list of CMA members.) During these meetings CMA members worked on a strategic plan to be presented to the Education Assessment and Accountability Review Subcommittee of the Kentucky General Assembly in September 2005. This report presents the consensus plan developed by the CMA.

While recognizing the extensive amount of work in mathematics education that has already been accomplished by state agencies and organizations, school districts, educational consortia, and postsecondary institutions across Kentucky since the implementation of the Kentucky Education Reform Act of 1990, the CMA identified four critical areas of need that must be addressed in order to improve mathematics performance at all levels of schooling in Kentucky.

Areas of Critical Need

The CMA reached consensus on the following four critical needs that, if met, will lead to improved mathematics performance by Kentucky students at all levels:

- Create an environment for supporting high-quality mathematics instruction by enhancing the beliefs and attitudes of students, teachers, instructors, faculty, administrators, parents and community members about mathematics.

- Enhance Pre-K through 16 teachers' mathematics knowledge and ability to differentiate instruction to meet the needs of all students.

- Enhance the awareness and knowledge of Pre-K-12 teachers, adult educators, and postsecondary regarding effective mathematics resources, including curriculum materials, intervention and remediation programs, and technology, and provide them the support necessary to use the resources effectively.

- Increase the number of Kentucky teachers with expertise in mathematics and mathematics teaching through aggressive recruitment programs and support-based retention strategies.

In the table that follows, the CMA (1) provides brief rationales for each need, (2) recommends particular strategies that will lead to improved mathematics performance, (3) identifies specific groups, agencies, and organizations to implement the strategies, and (3) offers a tentative timeline for their implementation.

Need #1: Create an environment for supporting high-quality mathematics instruction by enhancing the beliefs and attitudes of students, teachers, instructors, faculty, administrators, parents and community members about mathematics.		
Rationale: Mathematics is an essential skill in today's society; yet many parents, educators, and policy makers do not appreciate the need for quality school mathematics (NCMST, 2000; Wagner, 2005; Achieve, 2004). Many persons, including school administrators and teachers, hold negative attitudes toward mathematics (Wagner, 2005, p. 10). In many schools, particularly in the early grades, considerably more emphasis is placed on literacy than on mathematics (NCES, 2004). Establishing an environment whereby students are encouraged to learn mathematics and mathematics teachers receive sufficient support and resources to teach mathematics effectively is a challenge.		
Strategy	**Responsible Organization(s)**	**Timeline**
Develop and provide professional development experiences for administrators, especially K-12 principals and central office staff, adult education program directors, and postsecondary deans and department chairs, that focus on building positive attitudes and supportive beliefs and that assist them in evaluating mathematics programs and make them aware of resources currently available to improve mathematics programs. The Center will draw from resources like *Lenses on Learning* (Nelson, 1998) and *A Principal's Guide to Mathematics Teaching* (McEwan, 2000) to develop the experiences.	Mathematics Center Kentucky Association of School Administrators	PD developed in summer 2006 and implemented in fall 2006
Prepare mathematics coaches to implement school-based programs for parents, community members, administrators, counselors, school councils, and other stakeholders to support the learning and teaching of mathematics.	Mathematics Center and implementation sites across Kentucky, Prichard Committee, Business Roundtable	Math coaches prepared in summer 2006 and work in schools beginning fall 2006. Additional math coaches prepared each summer thereafter.
Need #2: Enhance Pre-K through 16 teachers' mathematics knowledge and ability to differentiate instruction to meet the needs of all students.		
Rationale: Learning to teach is a life-long process because of the ever-changing roles and advances in technology and communication and because of emerging research on learning. Opportunities for teachers to engage in continuous learning about mathematics and relevant instructional strategies, however, are often limited (Ma, 1999). This section identifies two areas of deficiency—mathematics knowledge and differentiated instruction—for many teachers. Teachers at all levels have fundamental misconceptions about the mathematics topics they teach (e.g. Ma, 1999; Ball, 1990; Graeber and others, 1989; Even, 1993) Teachers at all levels also struggle to differentiate their instruction to meet the diverse abilities and learning styles of students; and teachers with professional development in differentiation and higher-level thinking get better results. When instruction is not differentiated or focused on higher-level thinking, minority and low SES students suffer the most (Cheng and Holyoak, 1999; Gentner, Ratterman, and Forbus, 1993; Lubienski 2002; Carey, 2005; Tomlinson, 2001). The needs are greater in adult education programs, where many mathematics teachers do not have mathematics majors. (Jennings and Whitler, 1997)		

Strategy	Responsible Organization(s)	Timeline
Prepare mathematics coaches for all grade levels to work with mathematics teachers in their classrooms, provide professional development for teachers, and serve as a resource for teachers. The coaches' preparation will include knowledge of and expertise in strategies and programs that build teachers' mathematics knowledge, enhance teachers' ability to differentiate instruction and develop students' mathematical power and reasoning, and engage teachers in a variety of job-embedded professional development including learning communities, lesson study, action research, demonstration sites, and analysis of student work. Schools and districts who wish to have mathematics coaches will develop comprehensive plans that include: the needs of the school/district, the plans for the upcoming year for the coach and the other teachers in the school/building, and a plan for continuing the project when the funding ends. The Mathematics Center will draw upon an extensive body of literature on coaching and mentoring, brain functioning research, and best practices in mathematics teaching, as well as existing expertise in Kentucky's schools and universities, to select or develop a model for preparing mathematics coaches.	Mathematics Center and implementation sites at the state universities across Kentucky. Teams of teacher leaders and faculty from Kentucky's universities and colleges will prepare coaches.	Math coaches prepared in summer 2006 and work in schools beginning fall 2006. Additional math coaches prepared each summer thereafter.
Identify mathematics and mathematics education courses and strategies such as pairing preservice teachers with exemplary inservice teachers during field experiences that are effective in improving preservice teachers' knowledge of mathematics content and content-specific pedagogy. A number of effective courses exist in the state and across the country. Workshops that focus on sharing these courses, as well as effective strategies for teaching them, will be made available to postsecondary faculty across the state.	Mathematics Center Council on Postsecondary Education	Workshops begin in the fall of 2006.
Identify strategies for addressing misalignment of mathematics curriculum, instruction, and assessment among pre-school, primary, intermediate, middle school, high school, adult education, and postsecondary, identify programs and strategies that result in strong alignment and assist schools and institutions, and develop plans for expanding these programs across the state.	Committee for Mathematics Achievement, P-16 Council, AIKCU, Kentucky Department of Education, Kentucky Adult Education Program	Completed by September 2006

Need #3: Enhance the awareness and knowledge of Pre-K-12 teachers, adult educators, and postsecondary regarding effective mathematics resources, including curriculum materials, intervention and remediation programs, and technology, and provide them the support necessary to use the resources effectively.

Rationale: Over the past ten years, researchers focusing on mathematics learning and teaching have developed a wide variety of curriculum materials, intervention programs, and remediation programs. Their effects on student performance are related to the nature of the curricula and the fidelity with which teachers implement the curricula and programs (Reys and others, 2003; Senk and Thompson, 2003). National and state data reveal that (1) many pre-school children enter kindergarten behind in reading and numeracy (Wagner, 2005; NCES, 2004), (2) growth in mathematics performance has been small in grades 5, 8, and 12 since 1999 (KDE, 2005; NCES, 2005), (3) mathematics achievement gaps among racial and SES groups are narrowing slowly for elementary, middle and high school students (KDE, 2005; NCES, 2005), (4) a significant number of high school students entering postsecondary require remediation in mathematics (NCES, 2004; SREB, 2002), and (5) a significant number of postsecondary students fail initial credit-bearing mathematics courses (SREB, 2002).

Strategy	Responsible Organization(s)	Timeline
Establish a clearinghouse of reviews that analyze K-12 mathematics curricula (especially those that lend themselves to differentiation), intervention programs, and remediation programs and make this analysis available to the Kentucky Department of Education and school districts across Kentucky. The criteria for these analyses will be: (1) research-based evidence of success, (2) challenging and developmentally appropriate mathematics that align with Core Content, and (3) easily differentiated for varied student abilities.	Mathematics Center, Committee for Mathematics Achievement	Reviews will be available to school districts through the Kentucky Department of Education website by summer 2006
Ensure mathematics coaches are knowledgeable about effective curricula and programs so that they can provide, or identify contractors to provide, professional development on implementation of these curricula and programs.	Mathematics Center and implementation sites across Kentucky	PD on primary intervention programs will be available fall 2005. PD on differentiated curricula and intervention/remediation programs in other grade spans will be available in summer 2006.
Identify benchmark diagnostic mathematics assessments and embedded, ongoing assessment that supports rich, complex reasoning and understanding that enhances transfer and long-lasting learning at all grade levels and prepare mathematics coaches to assist teachers in using these assessments in their mathematics instruction.	Mathematics Center	Existing assessments will be identified before summer 2006. Math coaches will be prepared summer 2006/begin work fall 2006.

Need #4: Increase the number of Kentucky teachers with expertise in mathematics and mathematics teaching through aggressive recruitment programs and support-based retention strategies.		
Rationale: Staffing Kentucky's Pre-K-12 classrooms with a sufficient number of teachers with mathematics expertise is a challenge in some areas of the state. In particular, there are shortages of qualified middle and high school mathematics teachers; elementary teachers, special education teachers, and adult education instructors often do not have sufficient mathematics and mathematics education preparation to teach mathematics effectively. Furthermore, retention rates of beginning mathematics teachers is relatively low (Ingersoll, 2001). Many middle school mathematics teachers do not have a sufficient number of mathematics courses to prepare them adequately (Clements and others, 1998).		
Strategy	**Responsible Organization(s)**	**Timeline**
Prepare mathematics coaches to establish school programs that engage middle and high school students with younger students in enjoyable mathematics endeavors such as mathematics clubs or competitions as well as tutoring, after-school programs, and email math buddies. The Teacher Cadet and Pro-Team Programs in South Carolina, Morehead's College Cadets provide excellent models for this activity.	Mathematics Center and its implementation sites at state universities across Kentucky, Kentucky Department of Education.	Many programs exist; others added during the 2006-07 school year. Math coaches prepared in summer 2006 and work in schools beginning fall 2006. Additional math coaches prepared each summer thereafter.
Establish mathematics teacher recruitment programs for mathematically talented students across Kentucky.	Kentucky regional P-16 councils, Kentucky Department of Education	Recruiting programs underway by September 2006.
Advertise the availability of scholarships, fellowships, and forgivable loans for preservice and inservice mathematics teachers at all levels P – 12.	Kentucky Department of Education, KHEAA	An aggressive advertising campaign will be established by April 2006.
Establish professional development programs to prepare mathematics specialists for elementary schools across Kentucky.	Mathematics Center and implementation sites at the state universities across Kentucky.	These programs will be developed during the 2006-07 school year for implementation during the summer of 2007.
Prepare mathematics coaches and exemplary teachers to mentor new teachers, especially in their third and fourth years of service and to establish learning communities of new and experienced teachers.	Mathematics Center and implementation sites at the state universities across Kentucky.	Math coaches prepared in summer 2006 and work in schools beginning fall 2006. Additional math coaches prepared each summer thereafter.

References

Achieve, Inc. (2004). *Ready or not: Creating a high school diploma that counts.* Washington, DC: Achieve, Inc.

Ball, D. L. (1990). Prospective elementary and secondary teachers' understanding of division. *Journal for Research in Mathematics Education, 21*(2), 132-144.

Carey, K. (2005). *The funding gap: Many states still shortchange low-income and minority students.* Washington, DC: Education Trust.

Cheng, P.W., & Holyoak, K.J. (1985). Pragmatic reasoning schemas. *Cognitive Psychology, 17*(4), 391-416.

Clements, S., Hartanowicz, P., & White, W. (1998). *The content preparation of Kentucky's middle grade mathematics teachers: A transcript analysis.* Frankfort, KY: Kentucky Department of Education.

Even, R. (1993). Subject-matter knowledge and pedagogical content knowledge: Prospective secondary teachers and the function concept. *Journal for Research in Mathematics Education, 24(*2), 94.

Gentner, D., Ratterman, M.J., & Forbus, K.D. (1993). The roles of similarity in transfer: Separating retrievability from inferential soundness. *Cognitive Psychology, 25*, 524-575.

Graber, A. O., Tirosh, D., & Glover, R. (1989). Preservice teachers' misconceptions in solving verbal problems in multiplication and division. *Journal for Research in Mathematics Education, 20* (1), 95-102.

Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal, 38*, 499-534.

Jennings, E. T., Whitler, E. T. (1997). *Adult literacy in Kentucky: A report on the Kentucky adult literacy survey*. Kentucky Department for Adult Education and Literacy.

Kentucky Department of Education (2005) Kentucky performance reports and briefing packets. Frankfort: Kentucky Department of Education. http://www.education.ky.gov/KDE/Administrative+Resources/Testing+and+Reporting+/Reports/default.htm

Lubienski, S. T. (2002) A closer look at black-white mathematics gaps: Intersections of race and SES in NAEP achievement and instructional practices data. *Journal of Negro Education, 71*(4), 269-287.

Ma, L. (1999) *Knowing and teaching elementary school mathematics*. Mahwah, NJ: Lawrence Erlbaum Associates.

McEwan, E. K. (2000). *The principal's guide to raising math achievement*. Thousand Oaks, CA: Sage Publications.

National Center for Education Statistics. (2004) *The condition of education 2004*. (NCES 2004-077) *Education Statistics Quarterly*, *6* (1/2). http://nces.ed.gov/programs/quarterly/vol_6/1_2/7_1.asp

National Center for Education Statistics (2005). NAEP Trendlines. Washington, DC: NCES. http://nces.ed.gov/nationsreportcard/ltt/results2004/natmathinfo.asp

National Commission on Mathematics and Science Teaching for the 21st Century. (NCMST) (2000) Before it's too late: A report to the nation from The National Commission on Mathematics and Science Teaching for the 21st Century. Washington, DC: U.S. Department of Education.

Nelson, B. S. (1998). Lenses on learning: Administrators' views on reform and the professional development of teachers. *Journal of Mathematics Teacher Education, 1*(2), 191-215

Reys, R. E., Reys, B. J., Lapan, R., Holliday, G. & Wasman, D. (2003). Assessing the impact of standards-based mathematics curriculum materials on student achievement. *Journal for Research in Mathematics Education, 34*(1), 74-95.

Senk, S. L., & Thompson, D. R. (Eds.). (2003). *Standards-based school mathematics curricula: What are they? What do students learn?* Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.

Southern Regional Education Board. (2002). Student readiness for college: Connecting state policies. Retrieved from http://www.sreb.org.

Tomlinson, C. A. (2001). *How to differentiate instruction in mixed ability classrooms. 2md edition.* Washington, DC: Association of Supervision and Curriculum Development.

Wagner, S. (Ed.) (2005). *PRIME: Prompt intervention in mathematics education.* Columbus, OH: Ohio Resource Center for Mathematics, Science, and Reading/Ohio Department of Education.